REMARKS

Applicant has carefully reviewed the Office Action outstanding in the present application, and in response has amended the claims to overcome the objections raised in the Action. The allowance of claims 2-9 and 16-21 and the allowability of claims 10-13 and 15 is acknowledged with appreciation. In view of the foregoing amendments and the following remarks, it is believed that all of the claims are now in condition for allowance, and favorable reconsideration of the application is respectfully solicited.

The present invention is directed to a ring-type monolithic semiconductor laser having input and output facets, and operating to convert an optical signal having a first wavelength to a corresponding optical signal having a second wavelength. As described herein, the ring laser is activated, as by a first input signal at a first wavelength, to cause light to propagate in the ring in a first direction (for example, counter-clockwise). This propagating light produces an output signal, or beam, from the output facet at the first wavelength.

Application of a second input signal at a second wavelength to an input facet of the ring laser is directed to cause light to propagate in the ring in a second direction (for example, clockwise). If this second input signal has an intensity that is greater than the first input signal, the light in this laser will change directions, and propagate in the second direction. This will switch off the original output beam.

The device of the invention also operates as an inverter, for on-off modulation of the second input signal will cause the output signal to switch between off and on states, respectively, thus converting the modulated input signal at a second wavelength into a corresponding inverted modulated output signal at the first wavelength. The converter device described above is defined in independent claims 1, 9 and 14, and in the claims dependent thereon.

The method of the present invention is defined in independent claim 2 and in the claims dependent thereon as being a process for converting an optical signal of a first wavelength to a corresponding optical signal of a second wavelength. This process includes activating the laser to produce an output at a first wavelength, and supplying a second wavelength signal to selectively switch the first wavelength output on and off to thereby modulate the laser output.

Claims 1 and 14 have been rejected under 35 U.S.C. 103 as being unpatentable over Japanese Publication 8-186540 to Furukawa, it being said that the reference show all the features of the claims except the requirement that the device be monolithic. It is asserted that to make the Furukawa device monolithic would be "obvious".

The cited Japanese publication to Furukawa is a frequency mixer which has neither the structure nor the function of the present invention, and thus cannot render claim 1 obvious.

The cited publication discloses a laser configuration which includes an amplifier 1 coupled to a filter 2 to form a ring (Fig. 1). When oscillation occurs, a signal f1 circulates in the laser, but the device does not produce an output at terminal 11. When an external optical signal at frequency f2 is supplied to the laser at input 10 through coupler 5, it mixes with the existing signal at frequency f1 to produce a third mixed signal at frequency f3. The mixed signals are supplied through output coupler 6 to a filter 8, which extracts the desired signal f3, which is then supplied to output 11.

When the Furukawa device is activated, it does not produce a first wavelength output signal, as is required by claim 1, but simply produces an internally circulation signal f1.

This is directly contrary to the present invention, as defined in Claim 1, which states that the laser, when activated, produces an output beam of wavelength λ_2. The Furukawa device, when activated, does not produce an output signal; filter 8 prevents that. Furthermore, Claim 1 states that upon receipt of an input beam of wavelength λ_1 the output beam of wavelength λ_2 is switched off. The Furukawa device, in contrast, produces an output upon receipt of an input signal.

Thus, Furukawa's operation is directly opposite to that of the claimed invention. The claimed device produces an output at a first frequency/wavelength, and then uses a second frequency/wavelength signal to turn the first one off (and on). There is no suggestion of such a function in Furukawa, nor is a structure disclosed that would

produce such an operation. In fact, Furukawa is constructed specifically to prevent what applicant is claiming. Furukawa provides an amplifier 1a which serves as a mixer, while a filter 8 is connected to the amplifier output to prevent signal f1 from being emitted; in contrast, the present invention, as claimed, requires that signal f1 be emitted.

Furukawa, therefore, teaches away from the present invention , and cannot suggest a modification of its own teachings that would lead to applicant's invention since it is an essentially distinct device in both structure and function.

The English translation of the abstract for the Furukawa publication states that the ring laser 4 "oscillates" to produce an optical signal at frequency f1. When a signal light is "incident from an input terminal 10, a third signal at a frequency f3 is generated by generating four-wave mixture with the first signal at the frequency f1 and a second signal at a frequency f2 inside the amplifier 1a and the third signal is passed through a second optical filter 8 and extracted from an output terminal 11." It is clear from this teaching that signal f3 is only generated when an input signal of frequency f2 is introduced, and this occurs through mixing an amplifier 1a.

There is nothing in Furukawa that teaches or even suggests that the output light at frequency f3 is switched off when the input signal of frequency f2 is introduced, yet this is what claim 1 requires. To the contrary, in the absence of signal f2 there is no four-wave mixing in the amplifier, and as a consequence there can be no signal f3. Accordingly, the reference simply cannot teach the claimed invention.

Claim 14 was dependent on claim 1, and distinguished over the reference to Furukawa for the reasons given above. This claim is now in independent form, and thus now directly incorporates the features of claim 1 rather than incorporating those features by reference. In addition, claim 14 states that light is propagated in the ring laser in a first direction when the laser is activated, and is propagated in a second direction when the input beam is received.

The Office Action, in rejection claim 14, asserted that "there is no claimed relationships between the 'first direction' and the 'second direction', so that they could be the same or different." Applicants respectfully disagree. If a "first" direction and a "second" direction were to be interpreted as being the same, then there would only be one direction of travel of the light; there could not be a second direction. Therefore, by reciting first and second directions, it is clear that there must be at least two direction, and they cannot be the same.

However, to advance the prosecution of this case, claim 14 has been revised to define the propagation of light "in a first of two directions" and in "a second of two directions". In addition, claim 14 has been amended to correct typographical errors in the references to wavelengths λ_1 and λ_2.

Claim 14, as well as claim 1, is believed to clearly distinguish over Furukawa in reciting an output beam that is switched off upon receipt of an input beam in a ring laser. This operation is produced by the unique structure of the ring laser, which causes

it to operate both as a wavelength/frequency converter and an inverter. This is in contrast to the cited publication too Furukawa, which merely describes an optical signal mixer that produces an output f3 only upon the presence of signals f1 and f2. Nothing in Furukawa suggests either the claimed structure or its claimed operation, and accordingly claim 1 and 14 are believed to be clearly patentable.

Allowable claim 10 has been rewritten in independent form, and is now believed to be in condition for allowance. In claim 15, the designation of λ_1 and λ_2 have been corrected, as suggested in the Office Action. In claim 18, the recitation of a tunable laser has been removed; the claim now recites a modulating beam having a variable wavelength, thereby overcoming the objection set out in the Office Action. In claim 20, "laser" has been changed to - - lasers - -, as requested.

The claims now in the application are believe to be clearly allowable, and accordingly favorable reconsideration is respectfully requested.

Respectfully Submitted,

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Dated: October 17, 2005
Docket No. BIN 4